REMARKS

Applicant has carefully reviewed and considered the Office Communication mailed June 22, 2001. Claims 30 & 60 are amended; thus, claims 1-85 are now pending in this application.

Claims 30, 42, 56, 60 and 72 were also rejected under 35 U.S.C. 251 for being an improper recapture of broadened claimed subject matter surrendered in the application for the patent upon which the present reissue application is based. Applicant respectfully traverses. This rejection is improper, and Applicant has cited case law supporting this position. Claims 30, 42, 56, 60 and 72 are substantially narrower AND different than those claims surrendered in Applicant's amendment in the parent application, and distinguish from the art overcome in the parent application. The subject matter surrendered is the original claims, not all claims that do not have the added limitation. The reissue claims are not trying to recapture substantially the original claims that existed before amendment in the parent application. Rather, other different limitations are included in claims 30, 42, 56, 60 and 72 , and because of these other limitations, the subject matter surrendered is NOT recaptured.

By analogy, if the original claim had limitations A, B, and C, and the prosecution added limitation D, then the "cancelled claim" or subject matter surrendered is the claim to A, B, and C. The surrendered subject matter is not equal to any claim not having limitation D. The subject matter surrendered (i.e., A, B, C) is not recaptured by having reissue claims with limitations A, B, C, and E, particularly when the combination A, B, C, and E is not in the prior art. ***In re Richman (citation below)***. The analysis turns on substantiality of similarity of reissue to cancelled claims (i.e., ABCE vs. ABC), not on whether a particular limitation (D) is in all recaptured claims. *In re Wadsworth and Wickenden (citation below).*

The Examiner asserts that the limitations "at a substantially constant velocity," detector elements "which are substantially uniformly spaced" and "maintaining the . . . projector and the detector in a substantially fixed relation to each other" are omitted from the reissue claims 30, 42, 56, 60, and 72, and thus these claims improperly recapture subject matter surrendered in the parent application. Applicant respectfully traverses. The Examiner originally cited *Hester Industries v Stein, In re Clement, and Ball Corp. v. United States*, but has not cited how this case

law supports his position, nor refuted the case law cited by Applicant for the opposite position.

These added claims have other limitations that were not in the original claims, and which in combination distinguish over the cited references.

The proper focus is on the scope of the claims, not on the individual feature or element purportedly given up during prosecution of the original application. *Ball Corp. v. United States,* 29 F.2d 1429, 1437; 221 U.S.P.Q. 289, 295 (Fed. Cir. 1984), ***In re Richman*, 409 F.2d at 274-75, 161 USPQ 359 at 362-63 ("We therefore find [no authority] for the proposition that a limitation added to a claim in obtaining its allowance cannot be broadened, under present statutory law, by reissue if the limitation turns out to be more restrictive than the prior art required. Certainly one might err without deceptive intention in adding a particular limitation where a less specific limitation regarding the same feature, or an added limitation relative to another element, would have been sufficient to render the claims patentable over the prior art.")**. See also *In re Wadsworth and Wickenden*, 27 C.C.P.A. 735, 107 F.2d 596, 43 U.S.P.Q. 460, 464 (analysis turns on substantiality of similarity of reissue to cancelled claims). In *Wadsworth*, the difference between the cancelled claims and the reissue claims was in the preamble, and the reissue process was substantially identical to that of the cancelled claims. However, in *Ball Corp. v. United States,* the reissue claims (which were upheld) were determined to be intermediate in scope -- broader than the claims of the original patent yet narrower than the canceled claims. *Ball* 221 U.S.P.Q. at 295.

35 U.S.C. 251 bars broadening reissue filed later than two years after issuance of the patent. The present reissue application was filed July 8, 1998, within one year of the July 8, 1997 issue date of the parent, U.S. Patent No. 5,646,733.

Although it is well settled that a claim is broadened, so far as the question of right to reissue is concerned, if it is so changed as to bring within its scope any structure which was not within the scope of the original claim (in other words, a claim is broadened if it is broader in any respect than the original claim, even though it may be narrowed in other respects), the present reissue claims 30, 42, 56, 60, and 72 include other limitations that clearly distinguish over the cited art in a similar manner as the omitted limitations. A patentee may obtain a reissue claim that varies materially from a claim originally surrendered even though it omits a limitation added

to obtain issuance. *Ball Corp. v. United States, supra.* Claims are not within the recapture doctrine if they differ materially from the abandoned claims. In the present case, the reissue claims clearly are not materially similar to the claims originally surrendered, even though they omit limitations added to obtain issuance of the patent.

In the original case, keeping the projector and imager detector in a substantially fixed relation to each other, having detector elements which are substantially uniformly spaced, and moving the object relative to the projector at a substantially constant velocity provided that the same single area of the surface would be imaged at each successive detector element at different successive phases. However, having non-uniformly spaced elements is also not in the prior art, and moving at a non-constant velocity is also not in the prior art. Thus, these limitations are not required to distinguish over the prior art.

The Kuchel reference (5,135,308, cited in the parent application) described a projector having a movable grid, and which provided two different projection patterns that alternated in time and/or wavelength (color) such that height information could be derived. The imager and the object of Kuchel were **not** moved relative to one another to obtain different phase readings; rather the two patterns and/or the moving projection grid provided phase differences that could be detected or calculated.

The Bullock reference (5,488,478, cited in the parent application) operated on an entirely different principle, i.e., one or more laser beams were scanned in a spaced-apart transverse direction across a moving sheet of steel (i.e., perpendicular to the sheet motion), and a linear detector oriented in a longitudinal direction would detect the longitudinal displacement of the line caused by height changes. In the projector, three moving galvanometer mirrors (galvanometer scanners of a rotating or oscillating mirror system) scan the laser beam spot in a transverse direction (generally perpendicular to the direction of motion of the sheet) and at a non-perpendicular angle of incidence, so as the height of the sheet changes, there is a longitudinal shift in the spot (i.e., it moves parallel to the direction of sheet motion when height varies). However, the Bullock laser lines are spaced apart, and it is the scanned laser line that is measured (i.e., the displacement of its center by determining which pixel it falls on), rather than the phase between lines (i.e., measuring the intensity at one pixel). I.e., the laser spot of one line would

move to a different pixel (of, e.g., the 2048 pixels) of the SAME linear detector element. Thus, phase of the projection pattern is not measured. Rather the linear displacement of each line along the linear detector is measured. Further, a single spot area of the moving strip of steel moves along pixels of a single detector element, never across two or three or more. As noted on column 3 lines 25-33:

> "Images of the light patterns received on the receiving surface 12 are shown at 4a, 4b and 4c. The linear light sensitive arrays 14 are typically conventional charge coupled devices and the positions of each light pattern 4a, 4b, 4c, is determined by reference to the pixels of the array 14 which are activated by the respective light pattern. Each linear array 14 is separate from the arrays of the other cameras and the outputs from the several linear arrays are processed in parallel using electronic hardware."

In contrast, while reissue claim 30 omits certain limitations of the cancelled claim of the original application, it is also narrower by the fact of other limitations and distinguishes from the cited references by those limitations. Thus, since claim 30 does not recite a projector, the steps of: "projecting a pattern of light; and maintaining **the projected pattern of light** and the detector in a substantially fixed relation to each other" are appropriate and are sufficient to distinguish over the cited art. Further, while claim 1 recites "moving the object relative to the . . . projector at a substantially constant velocity . . . ; receiving the . . . signal . . . with a detector having a plurality of separate detector elements which are substantially uniformly spaced," the present reissue claim recites "imaging the imagable light signal onto the detector, the detector having a first, a second, and a third detector element, wherein <u>the area of</u> the surface of the object is imaged onto the first detector element at a first phase of the projected pattern of light, <u>the area of</u> the surface of the object is imaged onto the second detector element at a second phase of the projected pattern of light, and <u>the area of</u> the surface of the object is imaged onto the third detector element at a third phase of the projected pattern of light." Thus the invention of claim 30 obtains three images at three different phases of the same area of the surface, as <u>the area of</u> the surface is moved to image to the first, second and third detector elements. Thus, reissue claim 30 appears in condition for allowance, and such action is respectfully requested.

Regarding claims 42, 56, 60 and 72, each of these claims also includes limitations that distinguish the claim as a whole over all the cited references. Thus, these claims also appear in condition for allowance, and such action is respectfully requested.

The recapture rule is based on equitable principles. The claims of the reissue application are intermediate in scope: broader that the issued claims of the parent patent, but narrower than those cancelled so as to clearly distinguish from all the cited references.

§103 Rejection of Claims

Claims 30, 32-33, 35, 36, 38-42, 44-46, 48, 52-58, 60, 62-63, 65-66, 69-72, 74-76, 78, and 82-85 were rejected under 35 U.S.C. 103(a) as being unpatentable over Shigeyama et al. (5,450,204) in view of Halioua et al. (4,641,972). Applicant again respectfully traverses the rejection. Applicant submits that, contrary to the assertion of the Examiner, the patent of Shigeyama et al. does not "maintain[] the projected pattern of light and the detector in a substantially fixed relation to each other."

Shigeyama MOVES the light pattern relative to the detector between images. That's what the LCD does. See Figure 5(a)-5(d). Thus the claims of the present invention are not obvious.

Shigeyama et al. used the LCD pattern generator

> (see column 4 line 44-55: "Referring further to FIGS. 5(a) to 5(d), there is shown a method of driving the liquid crystal element 24. In this driving method, the electrode portions of the strip electrode 41 are driven so as to be shifted by 1/4 pitch, thus producing light patterns varying in four phases. More specifically, as shown in FIGS. 5(a), 5(b), 5(c) and 5(d), the liquid crystal element 24 is driven so that each set of two electrode portions of the strip electrodes 41 are successively turned ON to transmit light. The periods of the shift, directions and the number of division of the strip electrodes, etc. may be set as desired according to the driving circuit.")

to sequentially move the projected pattern of light (see Figures 5A-5D). This merely replaces a moving physical pattern grating in the projector with an electronically controlled LCD having movable nematic crystals that are moved by electric fields to generate moving patterns. Further, Shigeyama et al. does not "mov[e] the object relative to the projected pattern of light so as to **scan** the projected pattern of light across a surface of the object to generate an imagable light signal," but rather the object remains at a fixed location while it uses the LCD to scan the pattern, and then moves the circuit board to another fixed location to again scan using the moving pattern generated by the LCD. All measurements are made in a fixed location. When the imaging for an

area is complete, the object is moved to a new fixed area to be measured. This movement is thus due to the small field of view, and not to obtain different phases of the pattern of light.

not clear

Claims 30 and 60 have been amended to recite that the object is moved relative to both the projected pattern of light and the detector, so as to scan the projected pattern of light across the object. Claims 42, 56, and 72 all recited that the object and projector moved relative to one another to scan the light pattern.

Shigeyama scans the projected pattern of light (using the LCDs) while keeping the object and detector and the projector all in a fixed relationship. Thus the claims of the present invention are not obvious. Thus, claims 30, 42, 56, 60, and 71, and all their dependent claims appear allowable, and such action is respectfully requested.

The Examiner admits that Shigeyama et al. does not teach "the detector having a first, a second, and a third detector element, wherein the surface of the object is imaged onto the first detector element at a first phase of the projected pattern of light, the surface of the object is imaged onto the second detector element at a second phase of the projected pattern of light, and the surface of the object is imaged onto the third detector element at a third phase of the projected pattern of light." That is because Shigeyama images the same area of the object to the same detector element for each reading, and instead moves the pattern of light (by moving the liquid crystals in the LCD device of the projector) to obtain different phases.

Applicant submits that, contrary to the assertion of the Examiner, Halioua et al. also does not provide such a teaching. Rather, Halioua et al. again provides a moving or scanned sinusoidal phase pattern (the pattern moves relative to the detector: see Figure 1–the projector has a phase shifter, and Figure 7, the grating G is shown moving by the arrow), and with any particular detector (e.g., D_c of FIG. 7), records three images of a point D of the object with a phase increment of 120 degrees following each recording. See Column 3 lines 38-41 and 49-53 (emphasis added):

> "A sinusoidal intensity distribution can be projected on the surface to be profiled, e.g. by generating **an interference pattern between two coherent plane wavefronts or by projecting an image of a grating with sinusoidal transmission function distribution illuminated by an incoherent light source**. FIG. 2 illustrates an embodiment of the projection system and phase shifter 110 (of FIG. 1), which comprises a laser illuminated shearing polarization interferometer. The linearly polarized output beam from the laser 111 is spatially filtered by filter 112, which includes lens 113 and pinhole 114, and then sheared by a Wollaston prism W. The phase

> modulator includes a combination of a quarter wave plate Q and a rotatable polarized P. By rotating the polarizer, the sinusoidal intensity distribution of the interference pattern can be modulated. **A 180° rotation of the polarizer corresponds to a 2 pi phase modulation and this permits precise phase shifts. It will be understood that other types of phase shifters, for example polarization dependent phase shifters such as electro-optic modulators, may also be used in this system. The fringe period can also be easily changed by an axial translation of the Wollaston prism W.** A collimating lens L is used to conserve light and simplify the optical geometry."

Thus, the projector is moved (rotating the polarizer or axially translating the Wollaston prism) to phase shift (move) the light pattern relative to the imager. The movement of the pattern and projector is apparent even from the sections sited in the Office Action column 4 lines 10-13 and column 4 line 62- column 5 line 4:

> "A_n is one of the detectors in the array, located at the image plane and is used to measure the intensity at C on the reference plane and at D on the object. "
> "By recording N frames of intensity data, the phase seen by each detector in the array can be computed, both for the reference plane and the object surface. Based on the continuity of the phase function, starting from a reference location with zero phase, the integer M of Eq. (6) can also be determined by monitoring the computed phases between two adjacent detectors and identifying sharp phase discontinuities which result from the 2 pi transitions. "

See also column 7 lines 20-33 and column 8 lines 26-28:

> "Surface profile measurements were made, using the system of FIGS. 1, 2, on a general test object (a half cylinder with two sections having different radii), mounted on a reference plane and illuminated with a sinusoidally varying beam intensity as previously described. In order to generate a phase variation in both the horizontal as well as vertical directions an inclined set of fringes were projected on the object. FIG. 5 shows the deformed grating as seen by the detector array. Three images each were recorded for the reference plane and the object surface, with a phase increment of 120° of the projected fringe pattern following each recording, and processing was performed as previously described."
> "A particular detector such as Dc can measure the phase phi c at a point C on the reference plane as well as phi D on the point D of the object."

The three frames (see column 6 line 12-21) collected are of the object (which ***is not moved*** relative to the detector array) at three different phases of the light pattern (which ***is moved*** relative to the image detector array).

Thus, neither reference provides the limitations that the Office Action asserts that they do and they do not render the claimed invention obvious, and thus claims 30, 32-33, 35, 36, 38-42, 44-46, 48, 52-58, 60, 62-63, 65-66, 69-72, 74-76, 78, and 82-85 appear to be in condition for

allowance, and such action is respectfully requested.

Regarding claims 39-41, 52-54, 69-71 and 82-84, the Examiner asserts that it would have been obvious to one of skill in the art to add a second projected pattern of light. The Examiner asserts a rationale that using an extra projected light would provide better performance. Kuchel, cited by the Examiner, uses two patterns of light to achieve basic Moire functionality, and thus the Examiner has not provided any motivation or explanation of how adding a second projector into the invention of Shigeyama would or could obtain better performance. Applicant respectfully traverses the rejection and its unsupported rationale. The Examiner has the burden under 35 U.S.C. § 103 to establish a *prima facie* case of obviousness. *In re Fine*, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). To do that, the Examiner must show that some objective teaching in the prior art or some knowledge generally available to one of ordinary skill in the art would lead an individual to combine the relevant teaching of the references. *Id.* Further, the Examiner must avoid hindsight and must not use the teaching of the application as a template to reconstruct the invention.

In response to Applicants request under MPEP 2144.03, the Examiner has proffered the Kuchel reference. Kuchel does not support the Examiner's assertion. Kuchel projects barred patterns sequentially (time division multiplexing) and these are sequentially and individually recorded by its camera. The computer computes the differences. Thus, Kuchel uses multiple projections to obtain phase relationship ψ_1 ψ_2 and their difference $\Delta\psi$. Attempting to do any such combination of two single-phase projections combined into the invention of Shigeyama is unexplained and lacks enablement and workability.

Applicant submits that the Examiner has failed his burden to establish a *prima facie* case of obviousness at the time of the invention of any of the limitations of claims 39-41, 52-54, 69-71 and 82-84, and that these claims appear to be in condition for allowance.

Claims 31, 34, 37, 43, 47, 79-51, 59, 61, 63, 67-68, 73, 77, 79-81 were rejected under 35 U.S.C. 103(a) as being unpatentable over Shigeyama et al. and Halioua et al. as applied to claims 30, 32-33, 35, 36, 38-42, 44-46, 48, 52-58, 60, 62-63, 65-66, 69-72, 74-76, 78, and 82-85 above, and further in view of PRIOR ART. Applicant respectfully traverses the rejection. As described

above, those various base claims appear to be allowable over Shigeyama et al. and Halioua et al. as applied to those claims, and as described above, Shigeyama et al. and Halioua et al. do not apply to corresponding limitations of claims 31, 34, 37, 43, 47, 79-51, 59, 61, 63, 67-68, 73, 77, and 79-81. PRIOR ART is a trilinear array camera 24, for example, the Kodak CCD chip model KLI-2103 which has 3 rows of detector or sensing elements 25 each having 2098 CCD sensing elements per row. The Examiner admits that Shigeyama et al. and Halioua et al. do not teach a tri-linear array. The Examiner asserts a rationale that such trilinear camera would detect first second and third phase simultaneously and therefore speed measurements.

Applicant respectfully disagrees. Both Shigeyama et al. and Halioua et al. scan the projected phases but keep the camera and object fixed (not moving) relative to one another while obtaining the different phase measurements. Thus, each uses an array detector, with each pixel in an X-Y grid receiving an image from a single area of the object being measured. At successive times, successive images are recorded, each at a different phase due to the scanning of the phase pattern between image times. One each of these successive recorded phase images, the same area is imaged to the same pixel, however each at a different phase of the scanned pattern. If one were to replace the imaging devices of Shigeyama et al. and Halioua et al. with a trilinear array, one would obtain only successive trilinear images of three stripes of the object, rather than the entire object (each of the three imager stripes receives a different stripe of the object, rather than simultaneously receiving three phase measurements of a single stripe of the object as the Examiner asserts). Recording only three lines instead of an entire array is SLOWER, not faster. Further, multiple 3-line images would need to be stitched together, a further complication not suggested, enabled or explained.

Conclusion

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney (612-373-6949) to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Commissioner of Patents, Washington, D.C. 20231, on this ____ day of August, 2001.

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